## CLAIMS

What is claimed is:

1. A droplet ejection apparatus having a driving circuit and a plurality of droplet ejection heads, each of the droplet ejection heads including a cavity filled with a liquid, a nozzle communicated with the cavity, an actuator driven by the driving circuit, and a diaphragm displaced by the actuator, the droplet ejection head ejecting the liquid within the cavity through the nozzle in the form of droplets by driving the actuator with the driving circuit, the droplet ejection apparatus comprising:

a main power supply for supplying a power to the apparatus;

power cutoff detecting means for detecting cutoff of the main power supply;

a standby power supply which supplies a power to the apparatus when the power cutoff detecting means detects the cutoff of the main power supply;

residual vibration detecting means for detecting a residual vibration of the diaphragm displaced by the driving of the actuator; and

storage means for storing a vibration pattern of the residual vibration of the diaphragm detected by the residual vibration detecting means and/or information obtained from the vibration pattern;

wherein the droplet ejection apparatus is constructed so that, when the cutoff of the main power supply is detected by the power cutoff detecting means, the actuator is driven by the driving circuit, the residual vibration detecting means detects the residual vibration of the diaphragm displaced by the driving of the actuator, and the storage means stores the vibration pattern of the residual vibration of the diaphragm detected by the residual vibration detecting means and/or the information obtained from the vibration pattern.

2. The droplet ejection apparatus as claimed in claim 1,

wherein the residual vibration of the diaphragm detected by the residual vibration detecting means is a residual vibration of the diaphragm when the actuator is driven by the driving circuit to such an extent that a droplet is not ejected.

3. The droplet ejection apparatus as claimed in claim 1, further comprising head position detecting means for detecting whether or not the droplet ejection heads are located at a home position;

wherein, when the cutoff of the main power supply is detected by the power cutoff detecting means under the condition where the head position detecting means detects that the droplet ejection heads are not located at the home position, the droplet ejection heads are moved to the home position.

4. The droplet ejection apparatus as claimed in claim 1, further comprising:

protection means for protecting at least a nozzle surface of the droplet ejection heads; and

protection state detecting means for detecting whether or not the droplet ejection heads are in the protection state by the protection means.

5. The droplet ejection apparatus as claimed in claim 4, wherein the protection means protects the droplet ejection heads in the case where the droplet ejection heads are not in the protection state by the protection means when the cutoff of the main power supply is detected by the power cutoff detecting means.

6. The droplet ejection apparatus as claimed in claim 4, wherein the protection means is a cap for covering the nozzle surface of the droplet ejection heads.

7. The droplet ejection apparatus as claimed in claim 4, wherein the storage means stores the detection result by the

protection state detecting means.

8. The droplet ejection apparatus as claimed in claim 1, further comprising time measuring means for measuring a time period from the time when the cutoff of the main power supply is detected by the power cutoff detecting means to the time when the main power supply is switched on.

9. The droplet ejection apparatus as claimed in claim 7, further comprising time measuring means for measuring a time period from the time when the cutoff of the main power supply is detected by the power cutoff detecting means to the time when the main power supply is switched on.

10. The droplet ejection apparatus as claimed in claim 1, further comprising recovery means for carrying out recovery processing for the droplet ejection heads to eliminate an ejection failure;

wherein, when the main power supply is switched on after the cutoff of the main power supply has been detected by the power cutoff detecting means, the recovery means carries out the recovery processing for the droplet ejection heads to eliminate the ejection failure on the basis of the vibration pattern of the residual vibration of the diaphragm and/or the information obtained from the vibration pattern which are stored in the storage means.

11. The droplet ejection apparatus as claimed in claim 7, further comprising recovery means for carrying out recovery processing for the droplet ejection heads to eliminate an ejection failure;

wherein, when the main power supply is switched on after the cutoff of the main power supply has been detected by the power cutoff detecting means, the recovery means carries out the recovery processing for the droplet ejection heads to eliminate the ejection failure on the basis of the vibration

pattern of the residual vibration of the diaphragm and/or the information obtained from the vibration pattern, and information indicating whether or not the droplet ejection heads are in the protection state, which are stored in the storage means.

12. The droplet ejection apparatus as claimed in claim 8, further comprising recovery means for carrying out recovery processing for the droplet ejection heads to eliminate an ejection failure;

wherein, when the main power supply is switched on after the cutoff of the main power supply has been detected by the power cutoff detecting means, the recovery means carries out the recovery processing for the droplet ejection heads to eliminate the ejection failure on the basis of the vibration pattern of the residual vibration of the diaphragm and/or the information obtained from the vibration pattern, which are stored in the storage means, and time information measured by the time measuring means.

13. The droplet ejection apparatus as claimed in claim 9, further comprising recovery means for carrying out recovery processing for the droplet ejection heads to eliminate an ejection failure;

wherein, when the main power supply is switched on after the cutoff of the main power supply has been detected by the power cutoff detecting means, the recovery means carries out the recovery processing for the droplet ejection heads to eliminate the ejection failure on the basis of the vibration pattern of the residual vibration of the diaphragm and/or the information obtained from the vibration pattern, information indicating whether or not the droplet ejection heads are in the protection state, which are stored in the storage means, and time information measured by the time measuring means.

14. The droplet ejection apparatus as claimed in claim 10,

wherein the recovery means includes: wiping means for carrying out a wiping process in which a nozzle surface of the droplet ejection heads where the nozzles are arranged is wiped with a wiper; flushing means for carrying out a flushing process by which the droplets are preliminarily ejected through the nozzles of the droplet ejection heads by driving the actuator; and pumping means for carrying out a pump-suction process with the use of a pump connected to a cap that covers the nozzle surface of the droplet ejection heads.

15. The droplet ejection apparatus as claimed in claim 14, wherein the recovery means carries out the pump-suction process in the case where a cause of the ejection failure of the droplet ejection heads is intrusion of an air bubble into the cavity.

16. The droplet ejection apparatus as claimed in claim 14, wherein the recovery means carries out at least the wiping process in the case where a cause of the ejection failure of the droplet ejection heads is adhesion of paper dust in the vicinity of an outlet of the nozzle.

17. The droplet ejection apparatus as claimed in claim 14, wherein the recovery means carries out the flushing process or the pump-suction process in the case where a cause of the ejection failure of the droplet ejection heads is thickening of the liquid in the vicinity of the nozzle due to drying.

18. The droplet ejection apparatus as claimed in claim 1, wherein the vibration pattern of the residual vibration of the diaphragm includes a cycle of the residual vibration.

19. The droplet ejection apparatus as claimed in claim 1, further comprising ejection failure detecting means for detecting an ejection failure of the droplet ejection heads and a cause thereof;

wherein, when the cutoff of the main power supply is

detected by the power cutoff detecting means, the ejection failure detecting means detects an ejection failure of the droplet ejection heads and the cause thereof on the basis of the vibration pattern of the residual vibration of the diaphragm, and the storage means stores the detection result as the information obtained from the vibration pattern.

20. The droplet ejection apparatus as claimed in claim 19, wherein the vibration pattern of the residual vibration of the diaphragm includes a cycle of the residual vibration.

21. The droplet ejection apparatus as claimed in claim 20, wherein the ejection failure detecting means judges that: an air bubble has intruded into the cavity in the case where the cycle of the residual vibration of the diaphragm is shorter than a predetermined range of cycle; the liquid in the vicinity of the nozzle has thickened due to drying in the case where the cycle of the residual vibration of the diaphragm is longer than a predetermined threshold; and paper dust is adhering in the vicinity of the outlet of the nozzle in the case where the cycle of the residual vibration of the diaphragm is longer than the predetermined range of cycle and shorter than the predetermined threshold.

22. The droplet ejection apparatus as claimed in claim 19, further comprising recovery means for carrying out recovery processing for the droplet ejection heads in accordance with the cause of the ejection failure to eliminate the cause of the ejection failure;

wherein, when the main power supply is switched on after the cutoff of the main power supply is detected by the power cutoff detecting means, the recovery means carries out the recovery processing for the droplet ejection heads in accordance with the cause of the ejection failure to eliminate the cause of the ejection failure by using the detection result stored in the storage means.

23. The droplet ejection apparatus as claimed in claim 7, further comprising ejection failure detecting means for detecting an ejection failure of the droplet ejection heads and a cause thereof;

wherein, when the cutoff of the main power supply is detected by the power cutoff detecting means, the ejection failure detecting means detects an ejection failure of the droplet ejection heads and the cause thereof on the basis of the vibration pattern of the residual vibration of the diaphragm, and the storage means stores the detection result as the information obtained from the vibration pattern.

24. The droplet ejection apparatus as claimed in claim 23, wherein the vibration pattern of the residual vibration of the diaphragm includes a cycle of the residual vibration.

25. The droplet ejection apparatus as claimed in claim 24, wherein the ejection failure detecting means judges that: an air bubble has intruded into the cavity in the case where the cycle of the residual vibration of the diaphragm is shorter than a predetermined range of cycle; the liquid in the vicinity of the nozzle has thickened due to drying in the case where the cycle of the residual vibration of the diaphragm is longer than a predetermined threshold; and paper dust is adhering in the vicinity of the outlet of the nozzle in the case where the cycle of the residual vibration of the diaphragm is longer than the predetermined range of cycle and shorter than the predetermined threshold.

26. The droplet ejection apparatus as claimed in claim 23, further comprising recovery means for carrying out recovery processing for the droplet ejection heads in accordance with the cause of the ejection failure to eliminate the cause of the ejection failure;

wherein, when the main power supply is switched on after

the cutoff of the main power supply is detected by the power cutoff detecting means, the recovery means carries out the recovery processing for the droplet ejection heads in accordance with the cause of the ejection failure to eliminate the cause of the ejection failure by using the detection result and information indicating whether or not the droplet ejection heads are in the protection state, which are stored in the storage means.

27. The droplet ejection apparatus as claimed in claim 8, further comprising ejection failure detecting means for detecting an ejection failure of the droplet ejection heads and a cause thereof;

wherein, when the cutoff of the main power supply is detected by the power cutoff detecting means, the ejection failure detecting means detects an ejection failure of the droplet ejection heads and the cause thereof on the basis of the vibration pattern of the residual vibration of the diaphragm, and the storage means stores the detection result as the information obtained from the vibration pattern.

28. The droplet ejection apparatus as claimed in claim 27, wherein the vibration pattern of the residual vibration of the diaphragm includes a cycle of the residual vibration.

29. The droplet ejection apparatus as claimed in claim 28, wherein the ejection failure detecting means judges that: an air bubble has intruded into the cavity in the case where the cycle of the residual vibration of the diaphragm is shorter than a predetermined range of cycle; the liquid in the vicinity of the nozzle has thickened due to drying in the case where the cycle of the residual vibration of the diaphragm is longer than a predetermined threshold; and paper dust is adhering in the vicinity of the outlet of the nozzle in the case where the cycle of the residual vibration of the diaphragm is longer than the predetermined range of cycle and shorter than the predetermined

threshold.

30. The droplet ejection apparatus as claimed in claim 27, further comprising recovery means for carrying out recovery processing for the droplet ejection heads in accordance with the cause of the ejection failure to eliminate the cause of the ejection failure;

wherein, when the main power supply is switched on after the cutoff of the main power supply is detected by the power cutoff detecting means, the recovery means carries out the recovery processing for the droplet ejection heads in accordance with the cause of the ejection failure to eliminate the cause of the ejection failure by using the detection result stored in the storage means and time information measured by the time measuring means.

31. The droplet ejection apparatus as claimed in claim 9, further comprising ejection failure detecting means for detecting an ejection failure of the droplet ejection heads and a cause thereof;

wherein, when the cutoff of the main power supply is detected by the power cutoff detecting means, the ejection failure detecting means detects an ejection failure of the droplet ejection heads and the cause thereof on the basis of the vibration pattern of the residual vibration of the diaphragm, and the storage means stores the detection result as the information obtained from the vibration pattern.

32. The droplet ejection apparatus as claimed in claim 31, wherein the vibration pattern of the residual vibration of the diaphragm includes a cycle of the residual vibration.

33. The droplet ejection apparatus as claimed in claim 32, wherein the ejection failure detecting means judges that: an air bubble has intruded into the cavity in the case where the cycle of the residual vibration of the diaphragm is shorter than

a predetermined range of cycle; the liquid in the vicinity of the nozzle has thickened due to drying in the case where the cycle of the residual vibration of the diaphragm is longer than a predetermined threshold; and paper dust is adhering in the vicinity of the outlet of the nozzle in the case where the cycle of the residual vibration of the diaphragm is longer than the predetermined range of cycle and shorter than the predetermined threshold.

34. The droplet ejection apparatus as claimed in claim 31, further comprising recovery means for carrying out recovery processing for the droplet ejection heads in accordance with the cause of the ejection failure to eliminate the cause of the ejection failure;

wherein, when the main power supply is switched on after the cutoff of the main power supply is detected by the power cutoff detecting means, the recovery means carries out the recovery processing for the droplet ejection heads in accordance with the cause of the ejection failure to eliminate the cause of the ejection failure by using the detection result stored in the storage means, time information measured by the time measuring means, and information indicating whether or not the droplet ejection heads are in the protection state, which is stored in the storage means.

35. The droplet ejection apparatus as claimed in claim 19, wherein the recovery means includes: wiping means for carrying out a wiping process in which a nozzle surface of the droplet ejection heads where the nozzles are arranged is wiped with a wiper; flushing means for carrying out a flushing process by which the droplets are preliminarily ejected through the nozzles of the droplet ejection heads by driving the actuator; and pumping means for carrying out a pump-suction process with the use of a pump connected to a cap that covers the nozzle surface of the droplet ejection heads.

36. The droplet ejection apparatus as claimed in claim 35, wherein the recovery means carries out the pump-suction process in the case where the cause of the ejection failure of the droplet ejection heads is intrusion of an air bubble into the cavity.

37. The droplet ejection apparatus as claimed in claim 35, wherein the recovery means carries out at least the wiping process in the case where the cause of the ejection failure of the droplet ejection heads is adhesion of paper dust in the vicinity of an outlet of the nozzle.

38. The droplet ejection apparatus as claimed in claim 35, wherein the recovery means carries out the flushing process or the pump-suction process in the case where that the cause of the ejection failure of the droplet ejection heads is thickening of the liquid in the vicinity of the nozzle due to drying.

39. The droplet ejection apparatus as claimed in claim 1, wherein the ejection failure detecting means includes an oscillation circuit and the oscillation circuit oscillates in response to an electric capacitance component that varies with the residual vibration of the diaphragm.

40. The droplet ejection apparatus as claimed in claim 1, wherein the ejection failure detecting means includes an oscillation circuit and the oscillation circuit oscillates in response to an electric capacitance component of the actuator that varies with the residual vibration of the diaphragm.

41. The droplet ejection apparatus as claimed in claim 40, wherein the ejection failure detecting means includes a resistor element connected to the actuator, and the oscillation circuit forms a CR oscillation circuit based on the electric capacitance component of the actuator and a resistance component of the resistor element.

42. The droplet ejection apparatus as claimed in claim 40, wherein the ejection failure detecting means includes an F/V converting circuit that generates a voltage waveform in response to the residual vibration of the diaphragm from a predetermined group of signals generated based on changes in an oscillation frequency of an output signal from the oscillation circuit.

43. The droplet ejection apparatus as claimed in claim 42, wherein the ejection failure detecting means includes a waveform shaping circuit that shapes the voltage waveform in response to the residual vibration of the diaphragm generated by the F/V converting circuit into a predetermined waveform.

44. The droplet ejection apparatus as claimed in claim 43, wherein the waveform shaping circuit includes: DC component eliminating means for eliminating a direct current component from the voltage waveform of the residual vibration of the diaphragm generated by the F/V converting circuit; and a comparator that compares the voltage waveform from which the direct current component thereof has been eliminated by the DC component eliminating means with a predetermined voltage value; and

wherein the comparator generates and outputs a rectangular wave based on this voltage comparison.

45. The droplet ejection apparatus as claimed in claim 44, wherein the ejection failure detecting means includes measuring means for measuring the cycle of the residual vibration of the diaphragm based on the rectangular wave generated by the waveform shaping circuit.

46. The droplet ejection apparatus as claimed in claim 45, wherein the measuring means has a counter, and measures either a time between rising edges of the rectangular wave or a time between a rising edge and falling edge of the rectangular wave by counting pulses of a reference signal with the counter.

47. The droplet ejection apparatus as claimed in claim 1, wherein the actuator includes an electrostatic actuator.

48. The droplet ejection apparatus as claimed in claim 1, wherein the actuator includes a piezoelectric actuator having a piezoelectric element and using a piezoelectric effect of the piezoelectric element.

49. The droplet ejection apparatus as claimed in claim 1, wherein the actuator includes a film boiling actuator provided with a heating element that generates heat by conducting an electric current thereto.

50. The droplet ejection apparatus as claimed in claim 49, wherein the diaphragm deforms elastically so as to follow a change in the internal pressure of the cavity.

51. The droplet ejection apparatus as claimed in claim 1, wherein the droplet ejection apparatus includes an ink jet printer.